Claims

1.   A diagnostics system comprising:

a topological map of a target system that has nodes that correspond to components of the target system and links that correspond to connections between the components;

a knowledge store that has a structure that reflects or corresponds to that of the topological map, the store having a plurality of sections or libraries each of which is provided for storing data associated with one of the nodes defined in the topological map;

means for receiving data from one or more sensors on the target system;

means for including either the received data in the topological map and/or data that is a function of that received data, and

means for diagnosing faults using the data in the topological map and the knowledge store.

2.   A system as claimed in claim 1 comprising means for generating data using the received sensor data and adding that generated data to the topological map, preferably wherein the generated data is modelled data and/or activity status data that is indicative of whether a component is active and/or time derivative or dependent data that is indicative of any change in the data as a function of time.

3.   A system as claimed in claim 1 or claim 2 wherein one or more parameter nodes are provided in association with each component node for storing the received data and/or the generated data.

4.   A system as claimed in any of the preceding claims wherein the means for diagnosing comprise a plurality of diagnostic tools, preferably one or more domain independent diagnostic tools.

5.   A system as claimed in claim 4 wherein the domain independent diagnostic tool includes a correlator for nominating a component as being faulty on the basis of a correlation of behaviour of two or more components as a function of time.

6.   A system as claimed in claim 5, wherein the correlator is operable identify parameters that track faulty parameters and/or components that become active just before the occurrence of a fault and/or components that are being used at the time of occurrence

5   a fault.

7.   A system as claimed in any of the preceding claims including a topology analyser that is operable to identify components that are connected to apparently faulty components and nominate one or more commonly connected components as being faulty.

10

8.   A system as claimed in claim 7, wherein the topology analyser is configured to nominate a commonly connected component as being faulty if more than a pre-determined number of active components connected to the commonly connected component appear faulty.

15

9.   A system as claimed in any of the preceding claims wherein the means for detecting faults comprise a residual watcher that is operable to nominate a component as being faulty in the event that a sensed parameter is different from a modelled parameter and/or a constraint watcher that is operable to nominate a component as being faulty in

20   the event that a sensed parameter exceeds a pre-determined threshold or is outside a pre-determined range and/or an alarm watcher that is operable to nominate a component in the event that an alarm signal is received.

10.   A system as claimed in any of the preceding claims wherein for every component

25   identified as being potentially faulty there is included in the topological map a measure of a level of suspicion for that component, preferably wherein the measure of the level of suspicion is stored in the node for that component.

11.   A system as claimed in claim 10 wherein the measure of suspicion is monitored

30   using a suspicion index that is changed each time the component is nominated as faulty.

12. A system as claimed in claim 11 wherein the suspicion index is a pre-set integer, such as 0, for a component that has not been nominated and is incremented by 1 each time the component is nominated.

13. A system as claimed in any of the preceding claims comprising means for generating an ordered list of suspicious components, preferably with the most suspicious component presented first.

14. A method for diagnosing faults involving:

storing a topological map of a target system that has nodes that correspond to components of the target system and links that correspond to connections between the components;

storing a knowledge store that has a structure that reflects or corresponds to that of the topological map, the store having a plurality of sections or libraries each of which is provided for storing data, preferably component specific design data, associated with one of the nodes defined in the topological map;

receiving data from one or more sensors on the target system;

including the received data in the topological map, and/or data that is a function of that received data, and

diagnosing faults using the data in the topological map and the knowledge store.

15. A computer program, preferably on a data carrier or a computer readable medium, for diagnosing faults in a target system, the computer program having code or instructions for: receiving data from one or more sensors on the target system; including the received data in a topological map of the target system, the map having nodes that correspond to components of the target system and links that correspond to connections between the components and diagnosing faults using the data in the topological map and a knowledge store, the knowledge store having a structure that reflects or corresponds to that of the topological map, the store having a plurality of sections or libraries each of which is provided for storing data, preferably component specific design data, associated with one of the nodes defined in the topological map.

16.   A diagnostic tool that is configured or operable to nominate a commonly connected component in a target system as being faulty if more than a pre-determined number of active components connected to the commonly connected component appear

5   faulty.

17.   A diagnostic tool as claimed in claim 16 that is configured to interrogate a database or store to determine which components in the target system are designated as being faulty.

10

18.   A diagnostic tool as claimed in claim 17, wherein the database or store is a topological map of a target system that has nodes that correspond to components and links that correspond to connections between the components, and fault data and/or information is stored in association with the component nodes, preferably within the

15   component nodes.

19.   A diagnostic method that involves nominating a commonly connected component in a target system as being faulty if more than a pre-determined number of active components connected to the commonly connected component appear faulty.

20

20.   A computer program, preferably on a data carrier or a computer readable medium, the computer program having code or instructions for nominating a commonly connected component in a target system as being faulty if more than a pre-determined number of active components connected to the commonly connected component appear faulty.

25

21.   A method for diagnosing faults in a target system comprising:
       receiving sensor data for sensors in the target system;
       using the received data to generate system specific data, for example modelled
data;

searching for potentially faulty components by applying a plurality of diagnostic tools to the received and/or generated data, which tools are operable to nominate components that are potentially faulty;

storing a fault suspicion indicator for each component that is nominated as being faulty;

focussing the search for potentially faulty components using details of the nominated faulty components, preferably component specific design information and

creating a list of potentially faulty components based on the results of the steps of searching and focussing.

22.　　A method as claimed in claim 21 wherein the step of storing a fault suspicion indicator involves allocating a measure of suspicion to every potentially faulty component and changing this, typically increasing this, each time that component is nominated as faulty by one of the diagnostic tools.

23.　　A method as claimed in claim 21 or claim 22, comprising storing the sensor data and/or generated data as a function of time.

24.　　A method as claimed in claim 23 wherein the step of focusing uses the time dependent data to determine if there is a correlation between the behaviour of a faulty component and any other components.

25.　　A method as claimed in any of claims 21 to 24 wherein the step of focusing involves identifying commonly connected components associated with components that are suspected of being faulty.

26.　　A method as claimed in claim 25, wherein only active components are considered.

27.　　A method as claimed in any of claims 21 to 26 further comprising a step of analysing component specific data to determine whether components are faulty,

preferably wherein the component specific data is provided in a knowledge database that has the same structure as the topological model.

28.   A diagnostics system for detecting and/or diagnosing faults in a target system, the system being configured or operable to: receive sensor data for sensors in the target system; generate system specific data, for example modelled data, using the received data; search for potentially faulty components by applying a plurality of diagnostic tools to the received and/or generated data, which tools are operable to nominate components that are potentially faulty; store a fault suspicion indicator for each component that is nominated as being faulty; focus the search for potentially faulty components using details of the nominated faulty components and create a list of potentially faulty components based on the results of the steps of searching and focussing.

29.   A system as claimed in claim 28 further comprising a knowledge store that has a structure that reflects or corresponds to that of the topological map, the store having a plurality of sections or libraries each of which is provided for storing data associated with one of the nodes defined in the topological map.

30.   A computer program, preferably on a data carrier or a computer readable medium, for diagnosing faults in a target system, the computer program having code or instructions for:

        processing data received from one or more sensors on the target system to generate system specific data, for example modelled data;

        searching for potentially faulty components by applying a plurality of diagnostic tools to the received and/or generated data, which tools are operable to nominate components that are potentially faulty;

        storing a fault suspicion indicator for each component that is nominated as being faulty;

        focussing the search for potentially faulty components using details of the nominated faulty components and

creating a list of potentially faulty components based on the results of the steps of searching and focussing.

31.   A diagnostics system comprising: a topological map of a target system that has
5   component nodes that correspond to components of the target system, parameter nodes for storing data relating to an associated component node and links that correspond to connections between the components; means for receiving component data from one or more sensors on the target system; means for up-dating a relevant parameter node of the topological map as and when new sensor data is received, and diagnostics means
10   operable to use the data in the parameter nodes to diagnose faults.

32.   A system as claimed in claim 31 that is configured to store a fault suspicion index in each component node, and change that index for a given component, typically increase the index, in the event that it is suspected that the given component is fault.

15

33.   A system as claimed in claim 31 and claim 32 a knowledge store that has a structure that reflects or corresponds to that of the topological map, the store having a plurality of sections or libraries each of which is provided for storing data associated with one of the nodes defined in the topological map.

20

34.   A diagnostics method that uses a topological map of a target system that has component nodes that correspond to components of the target system, parameter nodes for storing sensor data relating to an associated component node and links that correspond to connections between the components, the method comprising: receiving component
25   data from one or more sensors on the target system; up-dating a relevant parameter node of the topological map as and when new sensor data is received, and using the data in the topological map to diagnose faults.

35.   A method as claimed in claim 34 comprising storing a fault suspicion index in
30   each component node, and changing that index for a given component, typically increase the index, in the event that it is suspected that the given component is fault.

36.   A computer program, preferably on a data carrier or a computer readable medium, for diagnosing faults in a target system that is represented by a topological map that has component nodes that correspond to components of the target system, parameter nodes for storing sensor data relating to an associated component node and links that correspond to connections between the components, the computer program having code or instructions for: receiving component data from one or more sensors on the target system; up-dating a relevant parameter node of the topological map as and when new sensor data is received, and using the data in the topological map to diagnose faults.